Steel Engrs. Library

OCT 15 1943

FOUNDRY TRADE JOURNAL

EST. 1902

WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

VOL. 71. No. 1413 SEPTEMBER 16, 1943

Registered at the G.P.O. as a Newspaper. Offices: 49, Wellington Street, Strand, London, W.C.2.

Single Copy 6d. (By Post 8d.) Annual Subscription, Home and Overseas, 21/- (Prepaid)

TISH
ULDING
CHINE Co. LTD
RSHAM, KENT

Used by many leading foundries
DISTRIBOND
the PROVEN British substitute for Bentonite
DISTRICT CHEMICAL COMPANY LTD.
1-10, New Oxford Street London W.C.1

STEIN
REFRACTORIES
FOR EVERY PURPOSE
JOHN G. STEIN & CO. LTD.
BONNYBRIDGE, SCOTLAND

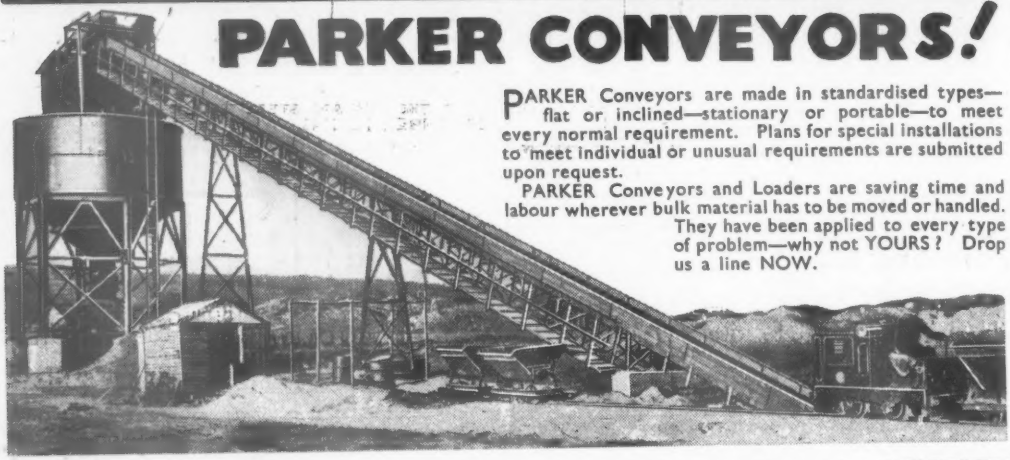
MANSFIELD
Moulding Sand

DAYS & ONIONS LTD.
BIRMINGHAM 11
& STEEL FOUNDRY PLANTS

THE ERITH RANGE OF SANDS
Combine a variety of selected LOAMS and SILICA SANDS of guaranteed quality, suitable for every appropriate foundry requirement. In all fundamental respects they are the outstanding sands for present-day practice, and are tried and proved by performance and results.
Write for illustrated Brochure and Free Samples to: ESTABLISHED 1805
J. PARISH & CO., ERITH, KENT. - Telephone No.: ERITH 2056

MAKE SHORT WORK OF IT with

PARKER CONVEYORS!



PARKER Conveyors are made in standardised types—flat or inclined—stationary or portable—to meet every normal requirement. Plans for special installations to meet individual or unusual requirements are submitted upon request.

PARKER Conveyors and Loaders are saving time and labour wherever bulk material has to be moved or handled. They have been applied to every type of problem—why not YOURS? Drop us a line NOW.

FREDERICK PARKER LTD. Extension 12, VIADUCT WORKS, CATHERINE ST., **LEICESTER**

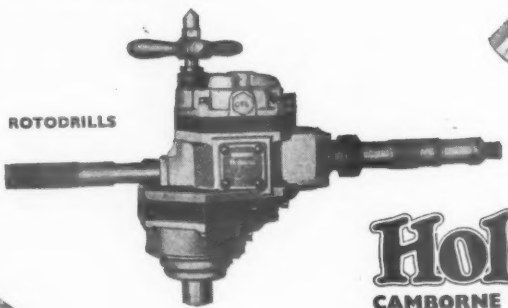
'Phone: Leicester 61273 (4 lines)

LONDON OFFICE and DEPOT: Extension 12, North Circular Road, Stonebridge Park, N.W.10 'Phone: Willesden 5007 & 6926

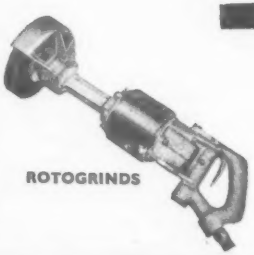
Holman

PNEUMATIC TOOLS

HAMMERS



ROTODRILLS



ROTOGRINDS

BROS. LTD.

Holman

CAMBORNE - - - ENGLAND

'Phone: Camborne 2275 'Grams: "Avdrill Camborne"

PNEUMATIC PLANT SPECIALISTS

FOUNDRY TRADE JOURNAL
Established 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 71 Thursday, September 16, 1943 No. 1413

On Being Research-Minded

Because of his close association with the foundry industry, the pamphlet written upon the subject, "Are you Research-minded," by Sir Harold Hartley, F.R.S., past-president of the British Cast Iron Research Association and the Institute of Vitreous Enamellers, will have a special appeal to our readers. It has been issued by the Federation of British Industries, 21, Tothill Street, London, S.W.1, and because of the author's connection with the foundry industry, much of it covers familiar ground. There is, however, one phase which Sir Harold stresses as demanding the attention of foundry directorates and owners. Put bluntly, he says, it is quite insufficient to subscribe to a research association, unless the subscriber reinforces this action by having on the staff a technologist capable of applying the results of published research. We would go still further, and insist that this technologist should be of such a calibre that he cannot merely interpret and apply, but, if necessary, influence the nature of the researches undertaken. We base this remark on conversations we have had with individuals who grumble that they have received nothing of value from their appropriate trade research organisation, but who, on being asked what subjects they would tackle if they were given the position of director, have given us answers which left no doubt in our mind that they had not even given a moment's thought to the subject. In plain English, neither their training nor outlook on technology was sufficiently developed to enable them to realise just what research work meant. These men were hard-headed businessmen, well qualified to pursue a progressive if somewhat hazardous course in the steering of the affairs of their concerns, and they only needed a high grade technologist as a business associate to insure that the hazards were minimised. The hazards in industry arise from two main sources: one being the discovery of improved design, better material or manufacturing methods by a competitor within the industry, and the second, the preference of the market for a material made by a quite different industry. This situation is so keenly appreciated by the largest industrial units, that they reduce all risks by supporting those appropriate research organisations to the extent of influencing the type of investigations undertaken; by instituting their own research laboratory, and by giving a seat on the Board to its director. Surely the first step to be taken by smaller concerns towards this obviously desirable end is to utilise the services of a technologist who shows every promise of fulfilling the destiny indicated. The problem which the owners of smaller concerns have difficulty in solving is the bridging of the gap between the multitudinous facets of research and their interpretation by one individual technologist. Yet the appointment of a scientist with a high reputation in one field will answer the purpose, due to the fact that he exchanges his specialised knowledge with others similarly placed in other fields. This is constantly seen to take place at meetings of technical institutes and research associations, as there is a recognition of these limitations in technological circles, not noticeably evinced where employers foregather. A secondary problem is the finding of such individuals, and their training mistakes have been made in the past by quite important concerns, through their failure to allow members of their staff adequately to participate in either regional or national technical activities. Attendance at lectures and conventions and the like was no concern of theirs. Yet it is the judgment given by the Institute organising these functions which enables an enlightened directorate to estimate the worth of their own employees. Moreover, the audience, unlike that of the theatre or cinema, is wholly understanding and critical, and

(*Continued overleaf.*)

Contents

On Being Research Minded, 41.—The Late Mr. F. S. Russell, 42.—Reclamation of Porous Non-Ferrous Castings, 42.—New Publications, 42.—Steelfoundry Problems, 43.—The Spectrographic Analysis of Cast Iron, 49.—Statistical Control, 51.—Primary Grade Aluminium Ingot, 52.—Obituary, 53.—Salvaging Used Roller Bearings, 53.—News in Brief, 54.—Deferment Ages Raised, 54.—Personal, 54.—Company Results, 56.—New Companies, 56.—New Patents, 56.—Raw Material Markets, 58.

THE LATE MR. F. S. RUSSELL

We regret to announce the death of Mr. F. S. Russell, who was best known to the foundry industry as Chairman of General Refractories, Limited, a position he relinquished a few years ago. He launched this concern in 1913 and under his management it became one of the most influential companies in the trade. Mr. Russell was a man of great organising ability and to his efforts are due the creation of most of the trade and technical activities in the refractory industry. He attached great importance to the activities of technical institutes and was never happier than when attending an international or overseas convention with the Iron and Steel Institute, the Institute of British Foundrymen, or meetings connected with the refractory trades. He had a fine gift for friendship; a flair for journalism and publicity; a pride in his adopted city of Sheffield; a confidence in research; and an unbounded enthusiasm for any project which interested him, whether it was cinematography or philately. He was bed-ridden for some months before his death, which took place at the age of 65 at Cheltenham. "Frank," as he was universally known, leaves behind him as a permanent memorial of his personality and energy an organised refractory industry to replace the chaos which he found on entering it a few years before the last war.

RECLAMATION OF POROUS NON-FERROUS CASTINGS

At the request of a number of the Service departments, the Non-Ferrous Sub-Committee of the Technical Committee of the Institute of British Foundrymen has prepared a report on "The Reclamation of Porous Non-Ferrous Castings by Bakelite Sealing Fluids." Copies of this report are available on application to the Institute, St. John Street Chambers, Deansgate, Manchester, 3.

ON BEING RESEARCH-MINDED

(*Concluded from previous page.*)

its judgment as to true work is seldom faulty. So far as the foundry industry is concerned, reflection will reveal that those concerns possessing technicians whose reputations have been made either in the technical institutes or research association circles are the least worried about Carey Street and confident of their future. These then are the thoughts which arose from reading Sir Harold Hartley's clarion call for industry to become research-minded. The major part of foundry industry is converted, but is still hazy in its notions as to just exactly how their individual concerns fit into the complete picture.

NEW PUBLICATIONS

Fusion Welding of Wrought Aluminium Alloys. Issued as Wrought Light Alloy Development Association Bulletin No. 5 from Union Chambers, 63, Temple Row, Birmingham, 2.

Although aluminium has been welded successfully for some 40 years, there are still a great many in industry who are not familiar with the technique required for fusion welding of aluminium, whilst even less is known about the welding of the alloys. This 52-page, well-illustrated Report deals first of all with the underlying reasons for the various difficulties encountered by operators inexperienced in the welding of aluminium. For example, the reasons for the difficulty of seeing exactly when fusion takes place, and the necessity for using flux mixtures of a certain type are explained. The characteristics of the metal affect the welding procedure required for each of the fusion processes are clearly described and a table is included summarising processes recommended for each type of aluminium alloy.

In addition to full descriptions of the oxy-acetylene and other oxy-gas methods, details are given of the metallic arc process, as well as several other processes not hitherto described in publications of this nature, such as the Weibel and Technotherm methods. The Report is very fully illustrated with both photographs and diagrams, particularly on those pages devoted to the preparation of the work, and the various welding techniques—leftwards, vertical upwards, etc. Flux compositions are summarised, and the methods of finishing, including removal of flux residues, are detailed.

Seven tables summarise basic data, such as gas consumption, electrode size and current requirements, and even the information required for estimating welding costs. There is also a short section on the inspection of fusion welds, with diagrams giving added point to the text. Copies are, of course, available to all responsible persons with an interest in the welding of wrought aluminium alloys from the Association.

Electrical Accessories.—The General Electric Company, Limited, of Magnet House, Kingsway, London, W.C.2, has prepared a booklet giving a complete list of revised prices for their electrical accessories. The prices in the list include all advances and adjustments up to August 9, 1943, from which date the revised prices operate. They refer to the material listed in the G.E.C. Catalogue S (1), 19th edition, dated July, 1938. Those who have not yet obtained a copy of this publication should apply to the head office of the company or to any of its branches.

Vacuum Cleaning of Moulds.—Deep and intricate moulds are effectively cleaned with vacuum nozzles at Continental Roll & Steel Foundry Company, East Chicago, Ind. A special lance nozzle is used to reach recesses and remove dust, sand and foreign matter quickly and economically. The method has been applied to a wide variety of moulds with success, it is stated.

STEELFOUNDRY PROBLEMS

JOINT SESSION OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE IRON AND STEEL INSTITUTE

Discussion of Three Conference Papers at London Meeting

A Joint Session of the Institute of British Foundrymen and the Iron and Steel Institute was held as part of the Annual Conference of the Institute of British Foundrymen on June 26 last. At this Session, over which MR. J. W. GARDOM presided, the following Papers were presented:—

No. 774.—"Hot Tears in Steel Castings," by Charles W. Briggs (Technical and Research Director of the American Steel Founders' Society). (American Foundrymen's Association Exchange Paper.)

No. 775.—"The Continuous Production of Manganese Steel Castings from the Tropenas Converter," by L. W. Bolton (Member) and J. Hill (Associate Member), introduced by Mr. Bolton.

No. 776.—"A Wartime Steel Foundry—Some Problems and Developments," by E. Derek Wells (Member) and A. Johnson (Associate Member), introduced by Mr. Wells.

Paper No. 774 was introduced by the following note prepared by Mr. P. C. Fassotte, which was read by Mr. V. C. Faulkner:—

INTRODUCTORY NOTE ON PAPER 774

It was with genuine pleasure that he presented and commended this year's American Exchange Paper, wrote Mr. Fassotte. The author's name was associated in foundrymen's minds with a most valuable series of contributions to the technique of steelfounding. When he heard that this Paper was forthcoming general expectations, therefore, were very high, and they have in no way been disappointed. The author had approached his subject in his characteristic manner, with a pertinacious search for the scientific explanation, yet never indulging in theory only, and never losing sight of the practical aspect; the same happy blend that made his previous Papers so acceptable to our industry where empiricism holds so much sway.

Of all the defects to which steel castings can be subject, hot tearing was the most pernicious, the most insidious, the most difficult to locate, and the most awkward to cure. For many years we were not fully cognisant of this defect, and were only aware of it when it was present in a blatant manner, say, in the form of a gaping gash on the surface of the casting. Only too often were foundrymen serenely unaware of the less discernible, fine, hairline crack, and only with the advent of magnetic testing and X-ray and gamma-ray investigation were they to be in the position of measuring the extent to which their products suffered from hot tearing. Prior to these methods of investigation, the industry was dependent on crude and inadequate processes of detection, such as sand-blasting after immersion in an oil bath, suspending castings on wires and relying on resonance to give an indication of soundness, or as a final resort, the always unfortunate method of sectioning a casting, and thereby destroying it. The non-destructive methods of testing were now enabling the steelfounder to become aware of the prevalence and magnitude of internal hot tears, to study their origin and thereby prepare the way for the remedy.

Non-destructive Testing

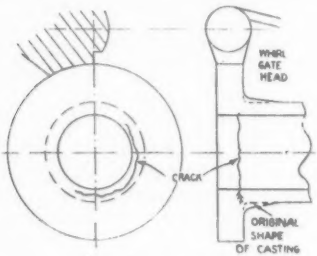
It was fortunate and timely that in the author's opening paragraphs he sketched the development of the non-destructive methods of testing in the United States. The picture he drew was impressive and well worth pondering over. It came at a particularly opportune moment, as X-ray and gamma-ray testing were so much in the forefront of the British steelfounders' preoccupations. The industry had undoubtedly been slow to move in this matter. Some founders have been viewing X-ray installations with suspicion, largely due to the fear that this method of testing might become an integral part of specifications and so increase manufacturing difficulties. This old-time attitude was that of the proverbial ostrich.

To-day the steelfounder was no longer happy merely because defects are not visible. A more enlightened view was now taken, and this change of opinion has been most rapid. X-ray testing was now considered as a help and no longer as a possible nuisance. The founder regarded it in the same way as the surgeon. He desired to be familiar with the inner structure and not merely with the outside. He required information on the location and extent of internal defects, confident as he is that his knowledge and skill would enable him to cure them. The steelfounder to-day was well on the way to considering non-destructive testing equipment as the indispensible adjunct of any steelfoundry. By drawing attention to the much more extensive use to which non-destructive testing was put in the States, the author had given an object lesson which was particularly welcome.

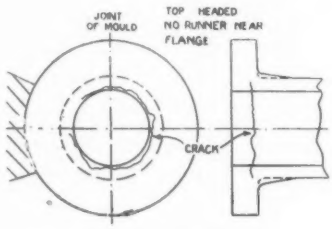
As the author explained, the formation of hot tears could not be disassociated from the presence of hindered stresses, and the analysis and origin of these stresses was extensive and convincing. The importance which was ascribed by the author to the ductility of the steel, which might even exceed the influence of strength at high temperature, was academically most interesting. To what extent, however, this fact could be applied was somewhat doubtful, as relative

Steelfoundry Problems

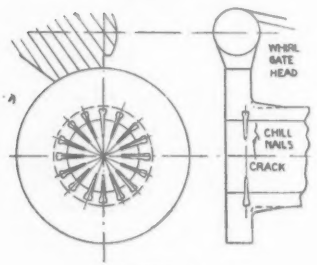
ductilities and strengths were bound to vary rapidly during the solidification period, and, in any case, were beyond calculation. Equally beyond calculation was resistance to contraction due to casting design, and nature of moulding materials. It was well known that different moulding media exhibited a varying proneness to the formation of hot tears. Certain sands had been known to cause more tearing troubles than others. One prominent British steelfounder had been attributing his freedom from hot tears to the use of a particular material which gave his moulds a high surface strength combined with a collapsible background. Mention might be made of the means whereby the resistance of the mould to contraction could be lessened and the practice often seen on the Continent of pouring water in pre-arranged cavities in the mould immediately after pouring, with a view of loosening the sand and preventing it from hindering contraction.



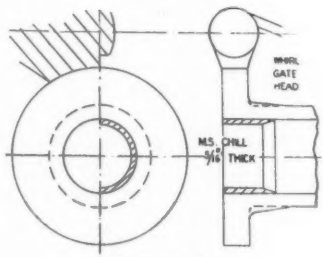
METHOD A.



METHOD B.



METHOD C.



METHOD D.

A Practical Investigation

One British foundry a few months ago had a run of hot tears at the inside of a flange at the end of a particular casting. The matter was investigated most closely from every aspect, and in Figs. A, B, C and D some of the various methods of casting are depicted. including the method which, in the long run, proved to be successful, namely, a half internal chill in the bore of the cylinder. He (Mr. Fassotte) had had the opportunity to go through the results of these experiments and compare them with the author's conclusions. This comparison might perhaps be of some interest:—

(1) Both basic and acid steels were tried. Generally speaking, the behaviour was the same, though results with basic steel were slightly better.

(2) The carbon range of the steels used was between 0.2 per cent. and slightly above 0.3 per cent. Tears were equally persistent with all the carbon contents.

(3) The sulphur variation in the steels employed was between 0.02 and 0.037 per cent., with no noticeable difference in results.

(4) The phosphorus variation, between 0.02 and 0.04 per cent., gave no different behaviour.

(5) The steels were examined for non-metallic inclusions without yielding any information. Sections of defective castings have, however, been sent to the author and he may have a different opinion on this point.

(6) The widest possible range of practical pouring temperatures gave no indication that the casting temperature had anything to do with the formation of this particular hot tear.

(7) Different moulding media and hardness of ramming were tried without any result.

The foundry in question agreed with the opinion of the author that steels with low and medium carbon content did not behave differently from the point of view of hot tears, and with the contention that no special importance need be attributed to the pouring temperature. The temperature gradients in the metal did not seem to be affected in any material way by a variation of pouring temperature; it took an internal chill to upset this temperature gradient and put an end to the trouble.

After these extensive experiments the foundry was inclined to attribute the principal reason for the trouble to insufficient fluid head of metal at the moment of solidification. In view of the heads provided, however, this explanation might not appear too convincing and it would be interesting to have the author's opinion. It will be noted that none of the author's

general conclusions was in any way invalidated by these tests. The author's Paper had done more. It had enforced clear thinking on an intricate subject. By his lucid analysis of causes and orderly marshalling of facts, he had dispelled many misconceptions and compelled the return to basic principles, a process always invaluable when dealing with a complicated issue. He (Mr. Fassotte) felt certain that he was voicing general appreciation as well as his own for a truly valuable Paper.

DISCUSSION AT CONFERENCE

MR. W. B. LAKE, J.P. (Past-President), said he thought the three Papers, to which he had listened with the greatest interest, pointed the way to a great improvement in steel castings. He had been very glad to hear Mr. Wells refer to the whirl gate head, because he felt that the industry had never sufficiently acknowledged the debt which it owed to the people who had invented it and who had thrown it open, free of charge, to the rest of them.

The Side-blown Converter

MR. MALCOLM BROWN, in speaking on Paper No. 776, said that he liked the stimulating and cheerful way in which the authors flitted from one topic to another, but he was sorry that they had not enlarged a little more on the future of the Tropenas converter. If there had been as much works research put into steelmaking by this process as had been put into steelmaking by high-frequency, electric-arc and the open-hearth processes, it would stand higher than it did at the present time. He noticed that the authors touched very lightly on the question of the photo-electric system for controlling the Tropenas, but he thought that that had great possibilities. He had learnt, however, that the mouth of the vessel should be kept as wide as possible so as to obtain a good flame area. Smoke hoods should be kept as large as possible to avoid obscuration of the observation point by smoke and fumes.

No mention was made of the accurate measurement of the volume of air consumed on the heats. There was a great deal to be learned from accurate measuring methods.

Another point he would be very tempted to try was the use of conditioned air. If one considered the variation of humidity which arose in this country at different seasons of the year and converted it into the quantity of water actually flowing into the vessel, it would be of great advantage when it came to putting in a plant to control the humidity of the air. This had been done to some extent in America in blast-furnace practice, and those who had used it said that it had great advantages. If it had great advantages in making pig-iron it probably had great advantages also in making steel.

"L" Gates

On the subject of the whirl-gate head, he did not want to detract from the interest of the work which had been done, but he would like someone to tell him what the whirl-gate head really was. The use of the old "L" head with tangential runners had been common practice for many years in some foundries. He had thought that the novelty of the whirl-gate head lay in the narrowness of the part connecting the base of the head to the wall of the casting, and the close proximity of the head to such wall so that one did not get the freezing effect which was obtained with the "L" head. If the drawings in the Paper were to scale, then he would have said that the crank at the top right-hand corner was an example of the "L" head. But he wondered whether the drawing was actually to scale. If it was, he would anticipate trouble across the neck which was shown.

MR. DEREK WELLS said that he thought the main point in these remarks calling for reply was the controlled air blast, and on that he agreed. There was no question about the truth of what Mr. Brown had said. One had so much coke and what one wanted was so much oxygen. Most of them would remember with a good deal of affection M. Deschamps, who died about eighteen months ago. He could recall him coming to his works and saying: "It is bright and frosty this morning, the humidity is low; you are getting a lot of oxygen in the air."

On the question of the whirl-gate head, he would ask Mr. Johnson to give his views on that subject.

MR. A. JOHNSON said that, on the question of the "L" head, he admitted that this had been much used in steelfoundry practice, but not to the extent to which the whirl-gate head was being applied at the present moment. The whirl-gate head could be used on any portion of the casting without considering anything on the top at all. As for the crankshaft shown in the drawing, the drawing was to scale; the distance of the head from the casting was only about 1 in., or even a little less, as nearly as they could possibly tell. In that case he did not think there was any danger of the ingate freezing before the casting was fed. The smaller ingates were certainly used with this process, which he considered to be definitely a big advance on the older methods of the "L" head.

Inclusions and Hot Tears

DR. J. C. DADSWELL, speaking on Paper No. 774, said that he had enjoyed reading this Paper particularly, because it referred to a difficulty with which they were all very familiar. It touched on the methods which they had all tried to adopt for the prevention of hot tears. The author dealt with one factor, however, to which significance had not been generally attached, namely, the question of the amount of inclusions and the inclusion type, in relationship to hot tears. On reflection he thought it was perhaps confirmed by experience with certain types of castings in open-hearth steel as compared with electric steel, because in the former there was a greater tendency to tears.

He was of the opinion that the steelmakers' processes as used in the steelfoundries could be investigated still further. There had been a tendency to investigate them more from the point of elimination of

Steelfoundry Problems

blowholes and soundness rather than from the effect of inclusions. He felt sure that further fundamental examination of steel-making processes, and here he was thinking mainly of electric steel-making, would show that there was a further field of work. A few years before the war, a careful study of acid electric melting, with particular reference to temperatures during the steel-making process, led to findings which had had far-reaching results, particularly on the very subject of inclusions and their influence on resultant mechanical properties of the steel.

He was of the opinion that the people in this country had not yet learned all that could be learned about deoxidation. They had not always allowed for the conditions which might have to hold good in the bath, to give the slightly different conditions necessary at the time of adding different oxidisers. Therefore, some of these alternatives had been condemned, although if studied differently and worked out, they might have proved to be an advantage. The Americans were enthusiastic students of different types of deoxidisers.

The Whirl-gate Head

With regard to Paper No. 776, Mr. Malcolm Brown had already covered one or two points, in particular the question of the whirl-gate head. A Paper on this subject was presented to the local Branch in Sheffield, following which he made some remarks in order to clear up what he thought was a misconception regarding its function. He considered that this contrivance was one of the greatest advances that had taken place in the steelfoundry industry for many years past. The responsibility and credit for these improvements had not been properly placed, probably because there was not always a proper idea as to how the whirl-gate worked. It was not so much the tangential runner which gave the whirl-gate head its effectiveness, as the manner in which the head was attached to the casting to keep hot the connecting portion between the head and casting. In 1937, when visiting America, he saw a device which he called a "cut-off riser." In that country they were then using heads in which the connection between the head and the castings was only about one-third or less in area as compared with the head. This was done by a wafer-like core, which, because of its thinness, permitted the junction to be kept hot.

About two years ago, Mr. Basil Gray, with whom he was working, suggested a particular case in which that type of junction between the head and the casting might be applied. That casting gave an excellent result without the tangential runner, but with the connecting piece as described. A few months later Mr. Gray visited Hopkinsons' works and saw a tangential runner and "L"-head which was no more than an ordinary "L"-head, such as was commonly used either at the top or the bottom of a casting. Therefore, he would like to couple Mr. Gray's name with that of the other gentlemen mentioned in the Paper as those to whom a debt was owing for their pioneer work. It is certain that without Mr. Gray's research into its functioning and his enthusiasm for its application, there would not have been the wide use of the whirl-gate head now prevalent. A document written by Mr. Gray has been circulated by the Iron and Steel Institute, and shows a number of examples of castings which have been made by the whirl-gate head method.

As regards the atmospheric riser which adds to the advantage of the whirl-gate head, he saw this being experimented with in the U.S.A. 12 months ago, just at the time of the publication of its details. It was applied to what he calls the "properly placed 'L'-head"—that is having a close connection and without the tangential runner. This brings to mind two important points—the fact that simultaneous development was taking place on both sides of the Atlantic, and again that it is not the runner so much as the position of the "L"-head which is so important. A point that Mr. Basil Gray has been responsible for developing and publishing.

Finally he wished to refer to the other subject which Mr. Wells and Mr. Johnson had mentioned, namely the Hydroblast system. He was sure that every steelfoundry would end by having something closely related to the Hydroblast system because of the immediate benefits which resulted from the washing and reclamation of sand.

MR. DEREK WELLS said that he knew that there had been a great deal of questioning as to why the whirl-gate head worked as it did. Perhaps the final answer to that question was not yet available. Not until the Paper by Taylor and Rominski was published was it seen how the whirl-gate head worked. Those authors pointed out that the temperature gradient between the head and the casting was more important than pure gravity, and if that was not the whole of the answer it went a long way towards supplying the answer. With regard to the Hydroblast, this might be a case where the by-product proved in the end more important than the main product.

Standardised Nomenclature

MR. C. H. KAIN, referring to Paper 775, thought the development in a short time of such an excellent technique, reflected very great credit on Mr. Bolton and Mr. Hill. He well remembered the day in August, 1940, when Mr. Gardom showed him a roofless, derelict building without power, water or sanitation, which he (Mr. Gardom) was about to convert into a production steelfoundry. In less than eight months (March, 1941) he had had the pleasure of being present when the first steel was blown during a howling snowstorm in the still uncompleted building. That was a day of notable memories, not the least being of Mr. Fitz-Herbert Wright starting his career as a steelmaker by punching out the converter tuyeres which he (Mr. Kain) had allowed to become frozen.

Since that day the plant had made great progress, a good deal of which was due to the methodical tackling of steel-making problems by Mr. Bolton and Mr. Hill. Converter practice was capable of reduc-

tion to very exact mathematical limits, and he had been very much concerned about the time which appeared to elapse before the flame appeared. Then it had dawned on him that what the authors called the flame some others called the boil, and he would like to ask Mr. Bolton and Mr. Hill to clarify this matter, because if there was a difference in terminology it would make the data very difficult indeed to compare. In his own case, the "flame" appeared at a constant time of about 5 min., but the "boil" appeared at a variable time, and it would be useful to get the terminology standardised.

The temperature readings given in the Paper were extremely interesting. The range of temperature quoted which he had previously suggested was the difference between sluggish steel and lively or hot steel, and he desired to know if the steel from the vessel at 1,540 deg. C. was considered sluggish and that at 1,580 deg. C. was considered hot and fluid? This would be an interesting sidelight on the argument as to the relative life of basic electric steel and converter steel. He, personally, contended that this was very largely a matter of temperature.

It was extraordinary to notice that increased manganese did not erode the lining of the converter. Most operators had found that an increase of manganese in the charge metal of the vessel over about 0.6 per cent. caused excessive erosion of the lining.

He was disappointed to find that the blowing angle was adjusted according to the appearance of the sparks escaping from the converter mouth. He considered that that was bad practice. If one standardised one's practice one should stick to it, and if a blowing angle for a certain charge had been agreed on, that angle should be applied with every charge, and one should not juggle about with it.

Factors Affecting Life of Linings

He desired to ask a question regarding the drying of the vessels before use. He had a little information which, unfortunately, owing to shortage of labour, he had not been able to follow up. The data he had collected, however, did indicate that the longer a rammed vessel was air-dried before use the better the lining life obtained from it. With an air-dried vessel one could safely expect a life of 110 to 120 heats. He wished to ask if the authors had any actual information on that point.

With regard to the addition of sand to prevent lining wear, it was not quite clear whether sand was added after every blow or only once per shift or once per day. In his own case he had abandoned this practice because he found there was an actual building up of the lining which kept the output of the vessel constant. His own output and timetable were based on the assumption that if one started with 25 cwts. on Monday, one should get to 35 cwts. by Friday or Saturday. Therefore in this case it actually resulted in a reduction of output and the method of adding the sand to the converter before blowing had to be abandoned. At the end of the Paper a cupola loss of 7 per cent. and a converter loss of 12 per cent. were recorded, and this total loss of 19 per cent. he considered excessive. With good practice an overall loss of not more than 15 per cent. should be experienced.

Paper No. 776 was very interesting and a great credit to Mr. Wells and Mr. Johnson. He would be glad to discuss it at greater length when he had had an opportunity of studying it with more leisure. They referred to the varied state of oxidation at the end of each blow and to the difficulties encountered in keeping sulphur and phosphorus low. If the composition and temperature of the cupola metal were standardised, the oxidation conditions at the end of the blow should not be variable. Variable oxidation conditions resulted entirely from juggling about with the vessel, such as "moving into or out of the wind," according to the appearance of the spark at the vessel's mouth, which was bad practice.

Whirl Gate Results

He congratulated them on Table I, in which they gave all the results and averages and also the maximum and minimum. He was very pleased to note the appropriate reference to the whirl-gate head in this Paper, and he could not agree with Mr. Brown that it did not show any radical departure from the old "L" head. They had all used the "L" and angle heads for many years, but the technique of applying the whirl-gate head in angle form had undoubtedly been developed by Davenport and Speakes. Although there was nothing new in the actual outline of this head, the application and technique of the present use of it were entirely due to them.

One of the advantages which they claimed for this method was an increase in yield of casting from liquid steel obtained by feeding 2, 3 or 4 small castings from one centrally placed whirl-gate head. In his own case, however, that had been a complete failure. The castings were not clean. If four castings were used, two of them, or usually even three, were dirty and tended to scab. He had had very poor results from trying to get two or three castings from the same head in green sand. Perhaps better results might be obtained with dry sand.

Sand Bonding Difficulties

The reference to the bonding difficulty was of interest, and although he had not had an opportunity of comparing the authors' remarks with his own experience, they seemed in general to agree on various points that Fulbond was an excellent bond as such, but not a good bond to use repeatedly. Fulbond had good strength, but low fusion point. It tended to ball up, and if it was to be used successfully, one must make large additions of new sand. He was faced with the problem when using Fulbond which is a native material, of obtaining adequate supplies of new sand, which was very difficult owing to the restrictions on transport. On the other hand, imported bentonite enabled one greatly to reduce the amount of new sand consumed in the foundry. Fulbond yielded excellent results in green sand and for small steel castings provided the consumption of new sand was heavy.

Could any data be given as to the amount of new sand it was necessary to consume in order to main-

Steelfoundry Problems

tain the highest quality in the castings? He, himself, gave some figures sometime ago in which he suggested that the increase was of the order of 25 per cent., but that was a very conservative estimate. The amount of new sand consumed as against bentonite bonding was, in his case, about double. This naturally depends upon the initial consumption of new sand per ton of castings produced.

The Dust Problem

He thought that the dust problem was greatly accentuated by wartime conditions and the worry and debility under which everybody was at present suffering. Nearly all his own people were told by the doctor to have a few days in the fresh air and then start again. The present was not a good time to study the dust problems, because not only were such problems accentuated by blackout and artificial lighting, but also there was a less skilled type of labour living under difficult conditions. Their physical condition, which was poor initially, was made worse by worry and wartime food and so forth, and the problem assumed an importance altogether out of proportion to its real value.

He was rather surprised to notice that there was no reference to the question of maintenance. This was the most important problem before any foundry which was production-minded at the present time. They could obtain numbers of people who could repair, but few who could maintain. That was a problem even in peacetime, but in wartime it was accentuated by the increase in working hours of the plant and machinery, and by the poor quality of the people with whom they had to deal. Also, with the advent of higher wages, the maintenance people only wanted to work short hours, come in late, and go home early. Maintenance was the greatest problem facing the production foundry to-day.

Significance of Temperature Readings

MR. L. W. BOLTON thanked Mr. Kain for his comments. Dealing first with his point on nomenclature and the question whether the flame appeared earlier in the blow than was stated, the experiment carried out proved that carbon did not oxidise appreciably until the silicon had fallen to the region of 1 per cent. The oxidation of carbon was the only reaction which would produce a flame and, if the silicon was high, a considerable time could elapse before the appearance of a flame. Sparks and hot gases appeared before this, but the only flame was the carbon flame.

With regard to the point on temperature readings, the figure of 1,590 deg. C. quoted by Mr. Kain was actually taken on the converter bottom after the steel had been teemed. The steel was undoubtedly hotter than this, as there was inevitably some loss of temperature from the converter lining before the reading was taken.

It was mentioned in the Paper that, with a temperature reading on the converter bottom of 1,550 deg. C., the actual metal poured into the first casting usually had a temperature of 1,510 deg. C. The steel from the converter, therefore, must be considerably above 1,550 deg. C., because 21 per cent. of lower temperature metal was added in producing the manganese steel, and also some time interval elapsed between the taking of the two readings. The main point, of course, with regard to the fluidity of manganese steel was that its melting point was considerably lower than that of carbon steel, so that normally, when produced by the process described, there was plenty of temperature in hand.

Lining Erosion from High Mn Content

With regard to Mr. Kain's query whether increased manganese did not add to lining erosion, he would not care to be dogmatic on this point. Using high manganese metal in the converter, there was a very considerable quantity of fluid slag formed, which would suggest that an increase in lining erosion might be expected. The experience gained on a limited number of heats was that there was no serious increase in lining erosion, but perhaps insufficient experience was available to be very definite on this point.

On the question of the angle at which the converter should be blown, he agreed with Mr. Kain that 15 deg. gave the best results. On the other hand, with continuous operation, where an interruption in the melting programme could cause a hold-up in the moulding section, this angle could not always be strictly adhered to. If for some reason the metal charged into the converter was a little short, there was sometimes not time to bring up a little more metal, and as long as the metal available was somewhere very near the ideal amount, a smaller blowing angle could be used with satisfactory results. The same applied if a little too much metal was charged, and it had been found that a few degrees either way in the blowing angle was not of very great importance.

Air-dried Linings

Regarding the air-drying of linings, experience was definitely that a lining which had been air-dried for seven to nine days gave superior results over a lining which was rammed up and used immediately. He was interested in Mr. Kain's remarks with regard to the addition of sand and his experience closely followed Mr. Kain's. If too great an addition was made, there could be a considerable build-up on the lining and the addition must be controlled to avoid this.

Mr. Bolton agreed with Mr. Kain that a total loss in the cupola and converter of 15 per cent. should, under normal conditions, be considered high. On the plant in which these observations were made, the production was very considerably higher than that for which the plant was originally designed. Because of this, the converter was being pushed to give rapid heats and the cupolas also were being worked at a higher rate than would be regarded as ideal for the type of charges melted. If a longer time could be allowed in obtaining heats from the converter, and if the cupolas could be operated with a softer blast on a reduced output, he was confident that losses could be reduced.

(To be continued.)

THE SPECTROGRAPHIC ANALYSIS OF CAST IRON

DISCUSSION AT LONDON CONFERENCE

This Paper, which was presented by Mr. F. B. Ling, Mr. J. McPheat and Mr. J. Arnott, F.I.C., at the recent annual conference of the Institute of British Foundrymen, is of outstanding interest in so much as it breaks new ground in the field of the control of cast iron. When presented to the Conference, it gave rise to a discussion which cleared up several interesting points. It was opened by DR. A. B. EVEREST (Past-President, London Branch), who recalled a visit he made about six years ago to a very well-known firm in America; a number of castings were made there in Ford alloy, and their practice was particularly interesting, as it depended on spectrographic control. A ladleful of cupola metal was transferred to a converter and blown to steel. A second ladle of the same cupola metal was then taken and poured together with the freshly-made steel into an electric furnace, where it was refined and alloyed. Thus, they produced a true steel mix iron running about 1.25 to 1.5 per cent. carbon. When refining and alloying were nearly complete, a pencil of the metal was cast and was taken to the spectrographic laboratory, where the essential elements were determined spectrographically in a few minutes. During that time the bath was held; afterwards the metal was adjusted as necessary and was cast. The spectrographic method appeared to be ideal for control of this type where one was casting a very large number of heats in one particular metal; he felt, however, more dubious whether it was generally applicable to jobbing analyses. The British Cast Iron Research Association and other organisations, he said, were interested in applying the spectrogram; but he was sceptical as to whether it was a reliable instrument for analysing different types of irons. He would like to know if it could be used for the analysis consecutively of a highly alloyed iron of, say, the Ni-Resist type, then a pig-iron, then an engineering casting.

With regard to the arc or spark which was struck in order to obtain the spectrograph, he had been under the impression that an arc was used in the firm he visited, this being struck between two pieces of the same metal. The authors of the Paper, however, referred to a high-voltage discharge between a carbon pencil and a block of the metal which was being examined. Was it really an arc, or was it something else?

Limitations Imposed

MR. ARNOTT replied that the spectrograph could not be applied as a general all-round instrument to all ranges of irons, since one iron was highly alloyed and another was not. At the same time, the spectrographic method was the best qualitative analysis method possible, showing which elements were present. Although the basis work done by the user might not be such as to give exact quantitative results for any sample, it would very often give the results closely enough.

MR. MCPHEAT, replying to the question concerning the arc and spark, said the arc was one of the first methods used for spectrographic analysis, and it was still a very good method; but it had not the same accuracy as the spark. For example, the arc would give an accuracy of about from $\pm$ 5 to $\pm$ 8 per cent. of the element present; the spark gave an accuracy very much closer, say, $\pm$ 3 per cent., particularly in low concentrations. One Paper claimed an accuracy of $\pm$ 5 per cent. of the elements present in 18 per cent. of chromium steel.

The arc uses d.c. of low voltage with a current of, say, 2 to 5 amps. As a result, a considerable area of the specimen is heated. The spark method operates with a 15,000-volt discharge at very low amperage, and produces much more localised heating of the sample.

Arc and spark lines differ in their characteristics; arc lines are very good for qualitative recognition, but have not the same constant intensity of spark lines.

Narrower Plates Suggested

A MEMBER said that the spectrographic method had distinct possibilities in the laboratory; he could appreciate also that in a foundry it would be very useful for the segregation of scrap or the examination of castings which were already made and in respect of which there was no urgency, but he suggested that it would be necessary to reduce the size of plate before it would be adopted for control purposes in medium-sized foundries, which would require only about a dozen estimations a day, and would normally want the results quickly. With the normal type of apparatus a number of estimations had to be made in order to ensure accurate results; he suggested that the instrument makers might be asked to make the plates of narrower cross-section, which would render the spectrographic method more economical and more rapid.

Most foundrymen, he supposed, would be more willing to consider methods which would give results whilst the metal was still in the ladle. Ladle additions were being made, and crude foundry tests had been developed which would give an idea of the properties of the metal before casting. With the spectrographic method it might be possible to make an estimation of the metal in a ladle within six minutes; any ladle of 2 or 3 tons capacity could be held for 6 min. before casting, so that there were possibilities in that direction. Of course, matters such as segregations and the possibilities of surface contamination would have to be carefully worked out. Further, spectrographic analysis was not a job that could be allotted to other than skilled people.

The Time Factor

MR. F. DUNLEAVY wished to compliment the authors upon a very interesting and unusual method of analysis. Often a great deal of trouble and irritation was caused by pouring moulds with unsuitable irons. Evidently the authors had eliminated any doubt in regard to the analysis of the metal in the ladle, and thereby enabled the foundryman to know before pour-

Spectrography of Cast Iron

ing that the metal was correct. The analysis was of less value three or four days after casting, when the foundryman could have quite a heap of scrap behind him. Any method that will assist in cutting down scrap, thereby saving man-hours in foundry, machine shop, etc., would be universally appreciated. He felt sure that the methods used by Mr. Arnott and his colleagues would be used in the near future far more extensively throughout the foundry world than they appeared to be at the moment.

Organisation Imposed

MR. ARNOTT replied that obviously the time factor was important. He and his colleagues had not to operate on quantities. It was quite true that a plate could be exposed, developed and interpreted in six or perhaps eight minutes; but that represented the best practice, involving the services of three operators, assisted by every mechanical aid available. They had to get a specimen, cool it, cut it and prepare a good surface, spark, develop the plate, wash it and dry it, put it on the microphotometer, take the readings for each element and consult the chart; obviously, to do that in six minutes involved extremely good individual and team work; yet it had been done.

With regard to effecting economies, it might be possible to reduce the size of the plate. In ordinary work, where the time element is not important, a large number of specimens could be dealt with on one plate, so that it was quite economical. But if there were a big demand for the apparatus for use in making rapid estimations, he imagined that the manufacturers would in due course, though not just now, meet that demand. The method had enormous possibilities, and anyone who had seen the Bragg Laboratory would realise that it had opened up a new field. It was only recently, and especially since Barker's work, that the very steep industrial development had been made possible.

WRITTEN DISCUSSION

MR. J. G. PEARCE wrote congratulating the authors of this Paper very warmly, both on the work they have done and on the fact of its publication. They were among the pioneers of spectrographic work on cast iron, probably one of the most difficult materials to which the method could be applied. Their comments on the following points would be appreciated.

Homogeneity was very important in the examination of cast iron. According to Barker, the sparking crater was about 1 mm. dia. With materials containing considerable amounts of phosphide eutectic or in which other segregates were likely to be present, the examination of one place only might lead to incorrect results. The examination of a point, for example, at which there might be a local concentration of phosphorus due to phosphide eutectic, would affect the determination of other elements, apart from the fact that the other elements would probably not be associated at this point in the same proportions as in the metal as a whole. The authors note that if homogeneity was in doubt, recourse must be had to the composite spark method, and it would be interesting to know their experience on this point. In the United States, they appeared to use an air-blast across the spark and hemispherically ended electrodes. Have the authors any information on the effect of different electrode shapes? In recent months the quality of photographic plates for photomicrographic work had deteriorated, and if the same lack of uniformity was present in spectrographic plates, much work will be involved in drawing new curves. Could the authors give an indication of the ranges of composition which could be determined for the various elements, providing an accuracy comparable with ordinary wet methods of analysis?

Authors' Reply

The AUTHORS, in reply, wrote that they were deeply indebted to Mr. Pearce for his comments and for raising several very relevant points. The authors did not experience any trouble which could be put down to segregation. The reasons for this were probably:—(*a*) The irons used had a moderately low phosphorus content, and (*b*) the craters were much larger than those obtained by Mr. Barker on steel samples. Mr. Barker gave a 10-sec. exposure, without added inductance, whereas the authors used finally a 30-sec. exposure (following a 10-sec. pre-spark), and 0.06 mH added inductance. The diameters of the craters on cast iron were approximately 6 mm. Without added inductance they were 2 mm. dia. The effect of added inductance on the size of the craters was remarked on by Mr. E. van Someren in the discussion on Mr. Barker's Paper.

Composite Spark.—This method was used in the earlier stages of the investigation, but was later discarded because there did not appear to be any need for it, and it added a little to the time involved, especially if the graphite electrode was changed between each of the fractional exposures.

Air Blast.—The authors had no direct experience of this. It was used very effectively by Dr. Convey in his work on the analysis of segregates.

Shape of Electrodes.—The authors had not tried hemispherically ended electrodes. They had observed, however, that under the conditions employed the pointed electrode loses its point in the first few seconds of sparking and becomes what is virtually a conical point with a very small hemispherical end. The change took place during the pre-sparking period.

Plate Quality.—The authors had seen reports indicating some falling-off in plate quality, but had not themselves experienced such to any appreciable extent.

Range of Composition.—Within the range covered in the experiments, *i.e.*, from about 0.3 per cent. to about 1.5 per cent. of each of the alloying elements, the spectrographic method gave results as accurate as those obtained by ordinary chemical analysis. By using other line pairs, and possibly with slight varia-

(*Continued on page* 53.)

STATISTICAL CONTROL

AN ACCOUNT OF AN ATTEMPT AT APPLICATION IN A LIGHT ALLOY FOUNDRY

By F. A. ALLEN and P. R. C. PYLE, A.I.C.

The authors noticed with great interest the leading article in this JOURNAL of May 6 last, on the subject of statistical control. With some hesitation they accept the implied invitation contained in the last sentence of the editorial for someone to come forward and give the industry the benefit of his experience. They write "with some hesitation," because the account offered can, without doubt, be criticised, for they attempted the application of quality control to foundry work without a real understanding of the process. It should further be pointed out that the attempt was made before the course of lectures on the subject was given at Sheffield University under the auspices of the Iron and Steel Institute, or before they could benefit from a lecture course given by Mr.

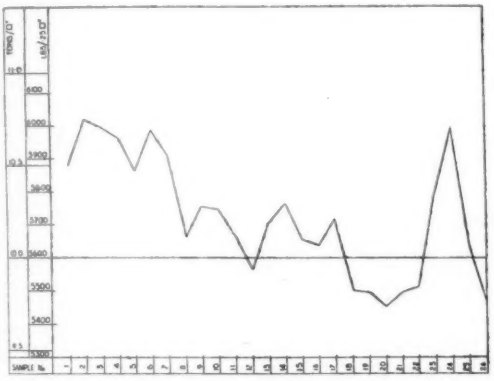


FIG. 1.—BEFORE CONTROL.

H. Rissik at Bristol Merchant Venturers' Technical College and arranged by the Ministry of Supply. The following account, therefore, is of a rather more personal nature than is usual in a technical Paper; it is felt, however, that the attempt taught valuable lessons, fulfilled a definite need as a reseach tool at the time, and did undoubtedly demonstrate the practical worth of the method.

The subject was first noticed by the authors in an article in the "G.E.C. Journal" about 1940. Their reaction was roughly that the subject was worth looking into. The British Standard Institution's publication No. 600 (1935), entitled "Industrial Standardisation and Quality Control," was studied. Frankly, the study proved to be quite difficult, and it was decided to attempt application, although the fundamentals were not fully understood. The demonstration in B.S. 600 of the fixing of control limits to a quality curve produced by statistical method was very attractive.

Choice of Control Value

The first question had to be answered—what value determinable in foundry work should be chosen for this experiment? The editorial prompting this account suggested that statistical analysis might be applied to such values as moisture content of moulding sand, pouring temperatures, chemical composition of alloys, mould hardness numbers—as indicating degree of standardisation of moulding method, and tensile strength. It was further remarked that perhaps there had been insufficient time for collection of data. The authors chose to work with tensile strength values

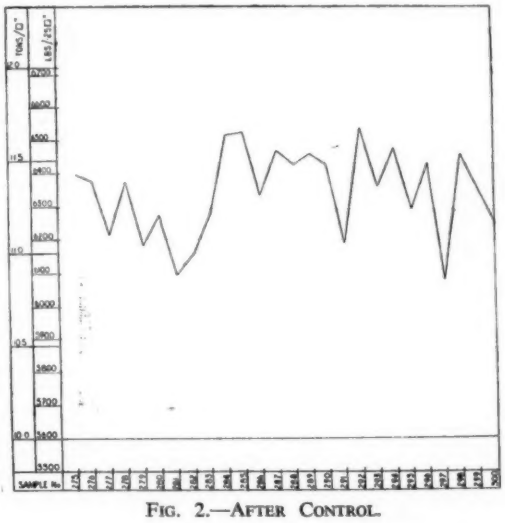


FIG. 2.—AFTER CONTROL.

precisely for the reason that the A.I.D. inspection system under which they worked required the recording of many mechanical test results daily, and here, therefore, to hand was an accumulation of data upon which to work.

The choice was of benefit for another reason. At the same time as it was proposed to assess the practical value of statistical control, joint laboratory-foundry experiments were going on with the object of developing a system of foundry control which, it was thought, would find reflection in tensile test results, if indeed test-bar results correlated to any extent with metallurgical soundness of castings. This latter question has been argued, of course, on many occasions, but it did seem reasonable to accept the fact that a test-bar was representative of the metal it was poured from, a result above specification requirements implying, at least, that the metal represented

Statistical Control

was of a good metallurgical standard of soundness, and confirming that the furnaceman had efficiently performed his job.

In choosing tensile strength it was thus possible to subject past results to statistical analysis, and by the application of such analysis to current production to see how the metallurgical control affected the general level of results. It should be noted, in passing, that the value of quality control lies chiefly in the presentation of current data: that is to say, one can be right up to the minute in graphic representation.

There appeared to be an initial difficulty. Quality control was applied, it seemed, to machine shop measurements having usually some tolerance of dimension, into which the reading of any part must fit or be scrapped. On the other hand, one is only concerned with a minimum specification in tensile strength; any reading greater is satisfactory.

After some work, however, and greater realisation of the statistical process, the difficulty disappeared. The deviation limits arrived at by statistical analysis are quite distinct from the engineering limits shown on a drawing dimension. Providing tools and skill are adequate to make a part within the tolerances specified, the statistical limits must fall inside them. A point on a quality control chart may therefore be outside the statistically-produced limits, but still be acceptable to the inspector. Value of the quality control method lies in the fact that such a point would indicate the operation of a major change, and therefore, warning being given, investigation should be made.

Statistical analysis of past data showed that results were not only consistently low in value, but were so scattered that it was obvious that the amount of control exercised was inadequate. In other words, the production of test bars, and probably of castings, also, was at the mercy of major factors emerging in a haphazard manner. Fig. 1 shows the scatter of results obtained during uncontrolled production. A system of metallurgical control was instituted, the resultant effect on test-bar results being shown in Fig. 2. Here it will be seen that apart from a higher level of results, scatter is much reduced.

Value of Control Chart

At this point it may be asked: in what way does a control chart aid control, seeing that it is the obvious duty of the foundry metallurgist to keep his eye on results?

In the first place, it must be admitted that one is tempted to be too easily satisfied in the daily knowledge that the majority of bars have passed on first test. The control chart has two advantages, however; it provides a graphical demonstration, and, in addition, serves to apply the commonplace of production engineering method to laboratory and foundry work. It should further be noted that a single point on the control chart represents the average of a statistical sample consisting of 5 or perhaps 10 results, so that the effect of the operation of a single chance factor, giving merely one low result, is ignored. On the other hand, a sample reading giving a point far away from the current standard can only mean that a major change is now operating against the attainment of the accepted level of results. Warning is therefore immediately given that something is going wrong, and attention should be given to the foundry process.

Earlier in this account, it was mentioned that there had been many discussions on the value of the test-bar. One incidental lesson from this trial of statistical control was that metal control giving high physical test figures did in fact give metallurgically sounder castings, for in the period of control the scrap fell from 7.2 to 4.8 per cent. over a period of 13 weeks. Since the major part of the output of the foundry was subjected to some form of radiological examination it seems fair to conclude that more efficient production had been achieved.

In conclusion, it is hoped that this account will provide the stimulus for further accounts of foundry quality control to appear from workers with greater experience and knowledge of the process. It is now clear to the authors, however, that the subject has not been fully exploited. Correlation of many factors could be made with the control chart, such as, for example, melt compositions in regard to scrap content and effect of changeover of shift workers. In a word, full use of statistical control would assist in the increased application of production engineering methods to foundry production, and this it must be agreed is desirable.

PRIMARY GRADE ALUMINIUM INGOT

In the United States, maximum prices have been fixed for primary grade aluminium ingot—a new grade of ingot made by blending from 50 per cent. to 70 per cent. of scrap with primary metal. The new maxima are:—For No. 142 primary grade ingot, 15½ cents per lb.; for No. 355 ingot, 15¼ cents per lb.; and for No. 195 ingot, 15 cents per lb.

To stimulate orderly movement of aluminium ingot made of scrap, the W.P.B. now is allocating virgin aluminium to smelters for blending with scrap in the production of critical casting alloys, Nos. 142, 355 and 195. Under the new programme smelters will be able to blend from 50 to 70 per cent. of scrap with primary pig and produce a primary grade ingot comparable in every respect with ingot produced solely of primary metal.

The cost to the smelter will be increased, however, since the primary pig costs 3 cents a lb. more than the highest grade scrap. As the primary grade ingot produced from blending primary and scrap metal is identical to the primary ingot sold by producers of virgin aluminium, the maximum prices established for Nos. 142, 355 and 195 ingot made by primary-scrap blending are established at the same levels as those for the same primary alloys.

WASTE PAPER IS NOT WASTE

THE SPECTROGRAPHIC ANALYSIS OF CAST IRON

(*Concluded from page* 50.)

tion of the operating conditions, the ranges could, no doubt, be extended a little, both upwards and downwards. Silicon may be exceptional in this respect and the difficulties with this element had already been referred to.

A Marked Advance

DR. J. E. HURST wrote that he would like it to be recorded that the Paper by Mr. Arnott and his colleagues, as far as he was aware, was the first public information before a British technical body on the application of the spectrograph to the analysis of cast iron. For this reason it was a Paper of very great importance, and deserved the particular attention of those who were faced with the problems of routine analysis under present-day conditions.

The application of the spectrograph to the routine analysis of cast iron was, of course, not new, and various concerns both in America and Germany had installed such equipment and had it in operation for some time. The information available of their experience with this equipment was just very scanty, and he had one hope that this Paper would be the means of encouraging some of our American friends to supply details of their experiences with this work in connection with cast iron.

The increase in the requirements of routine analysis had been brought about very largely by the residual elements which require to be determined. The writer's firm at Darlaston were proposing to instal similar equipment to that described in the Paper to deal with routine analysis of refined pig-iron. He took this opportunity of publicly thanking Mr. Arnott and his colleagues for the help and assistance that they had given already in connection with this matter, as also did Mr. Barker, of the Bragg Laboratory, Sheffield.

The AUTHORS wrote that they were very indebted to Dr. Hurst for his remarks. There was no doubt that the mass experience which would be accumulated by firms like Dr. Hurst's would result in a speedy widening of the scope of spectrochemical methods.

Steel Needs of Armed Forces

America's armed forces require annually the production of approximately 1,500 lbs. more steel per man than in the first world war. Furthermore, they are being equipped with steels vastly superior in quality to those produced in 1917-18, according to a report of the American Iron and Steel Institute. For each of the estimated 7,000,000 men in the United States armed forces at the end of 1942, over 24,600 lbs. of ingots was produced in a record-breaking production of 86,000,000 tons. In the last war, the average was about 23,100 lbs. of steel per man. Largely responsible for the increase in alloy steel produced from 920 to 3,240 lbs. per man in service is the present emphasis on air power and mechanised military equipment of all kinds.

OBITUARY

MR. HERBERT PAYNE, a director of Dawson, Payne & Elliott, Limited, engineers, of Otley, died suddenly on September 6, aged 68.

MR. ERNEST HOPKINS, director of Ironside, Limited, iron, steel, tinplate and metal merchants and exporters, of London, died recently.

MR. JOSEPH SHAW, a metal merchant with business interests in West Hartlepool, Newcastle-upon-Tyne, and other towns, died recently. He was 64.

MR. GILBERT JAMES ROBERT MILLINGTON, of Rowley Park, Stafford, died recently, at the age of 76. He was one of the founders of the Universal Grinding Wheel Company, Limited, and held the position of managing director from 1901 to 1922. He was with the firm right up to his death.

MR. G. B. CROSS, M.B.E., sales manager to Winget, Limited, of Rochester, died recently after only a few days' illness, at the age of 51. Mr. Cross had held an executive position with the company for over 20 years, and for the past three years he had also undertaken the management of the Concrete Pump Company.

MR. EDWARD CHARLES STRAKER, chairman of R. & W. Hawthorn, Leslie & Company, Limited, shipbuilders and engineers, Hebburn and Newcastle, since 1934, has died at the age of 53. He was also chairman of Robert Stephenson & Hawthorns, Limited, locomotive builders, Newcastle, and a director of other companies.

SALVAGING USED ROLLER BEARINGS

A scheme for re-using "used" ball and roller bearings and component parts has been started by the Bearing Control, Ministry of Supply. The scheme, which will ease the demand for new ball and roller bearings and effect economies in the use of material and man-power, aims at putting back into service used bearings which, in many instances, are perfectly suitable for secondary jobs, such as conveyors, castors, low-price plummer blocks, ball mills, etc. A former clothing factory near London is the pioneer depot for this work. Bearings considered to be too worn are broken down to recover balls and rollers, which are used for ball mill purposes (paint grinding, etc.). The residue is sorted into different scrap metal grades—brass, chrome steel, mild steel, duralumin, etc.—to facilitate usage by re-melters. The depot uses a simple but ingenious device for size-grinding used balls. Two sloping steel bars about 3-ft. long are clamped together at top and bottom with a space between which widens out to pre-determined angles. The balls are fed at the top of the device by the operator. They roll down until the space between the bars exceeds their diameter, and then drop into compartments provided for the purpose. During the few months the depot has been in existence many thousands of bearings have been reclaimed which would otherwise have been scrapped.

NEWS IN BRIEF

THE PORT TALBOT DRY DOCK AND ENGINEERING WORKS have been acquired by the Prince of Wales Dry Dock Company, Swansea, Limited.

SIR THOMAS ROYDEN, chairman of the L.M. & S.R., recently visited the locomotive building works of the company at Crewe, which is 100 years old this year. Sir Thomas Royden met many retired and present-day engine builders.

GEORGE BROWN & SONS, engineers and ship repairers, etc., of Broad Wynd, Leith, have become a private limited company registered under the name of George Brown & Sons Engineers (Leith), Limited. The capital is £20,000 in £1 shares.

C. A. PARSONS & COMPANY, LIMITED, of Newcastle-upon-Tyne, have opened an office in Bristol, and have appointed Mr. J. L. Packard as representative for the area, embracing South-West England and South Wales. The address is Litfield House, Litfield Place, Clifton, Bristol, 8.

THE THIRD War Production Foundry Congress of the American Foundrymen's Association will be held in Buffalo, N.Y., during the week of April 25, 1944. Displays of foundry equipment are to be limited to the exhibition of models and samples and the like in standard stands.

A JOINT MEETING of the Manchester Metallurgical Society, the Institute of Metals and the Iron and Steel Institute will be held on September 29, at 6.30 p.m., at the Engineer's Club, Albert Square, Manchester. Dr. W. H. Taylor will give a lecture on "Lattice Structures in Relation to Physical Properties of Metals."

DEFERMENT AGES RAISED

The Minister of Labour and National Service announces that, in view of the urgent needs of the Armed Forces, he proposes to raise the ages below which deferment will not ordinarily be granted or continued. The restrictions will apply to men born in or after 1915, 1910 or 1905 (*i.e.*, approximately men under 25, 30 or 35 at registration), as the case may be. We append a number of categories relevant to iron and steel, giving in brackets the earliest year of birth to which the restriction on the granting of deferment will apply:—

Bolt, nut, rivet finishers, gaugers, inspectors and labourers (1915); certain foundry workers, including charge hand foremen, core-makers (iron or steel castings), pipe or gutter moulders (1915); pattern-makers (grate and stove), pattern filers (1910); store-keepers in patternmaking shops (1915); foremen, roller-men, furnacemen, certain helpers in hot-rolling, doublers, openers and weighers in tinplate mills (1915); lampmen and lamproom attendants at ironstone mines or quarries (1910); foremen, drawn wrought iron nail and spike makers (hand trade), headers, pointers (hand or machine) in nail- and spike-making industry (1915).

PERSONAL

MR. W. E. OGDEN has been appointed a director of the Delta Metal Company, Limited.

MR. JOHN NEILL, of the North-Eastern Marine Engineering Company (1938), Limited, Wallsend-on-Tyne, has been elected chairman of the National Association of Marine Engine Builders for 1943-44.

MR. E. BERNARD JONES, commercial manager of Cammell Laird & Company, Limited, has been appointed secretary and accountant to the company in succession to the late Mr. S. Woodward.

CAPT. B. H. PETER, managing director of the Westinghouse Brake & Signal Company, Limited, is a member of the Colonial Economic Advisory Committee which has been set up by the Secretary of State for the Colonies.

MR. G. P. DAVISON, who was Deputy-Regional Controller, Northern Region, Ministry of Supply, has been appointed Regional Controller, Wales Region, in place of Mr. W. S. Steel. Mr. Steel has resigned from the position to return to his firm, the British Thomson-Houston Company, Limited.

MR. R. E. KENNEDY, the popular secretary of the American Foundrymen's Association, has been appointed administrative head, thus filling the vacancy caused by the resignation of Mr. C. E. Westover as Executive Vice-President (managing director), as previously announced. MR. C. E. HOYT has been elected treasurer of the Association.

MR. GEORGE KEITH, chairman and managing director of Keith Blackman, Limited, has been presented by the directors, staff and workers of the firm with a silver tray and a gold watch chain to mark the completion by him this month of 50 years' service with the company. The presentation was made by Mr. M. Burningham, financial director and secretary of the company, at a gathering of the employees, Mr. W. B. Richards, director and general manager, being in the chair.

MR. J. H. D. BRADSHAW has been appointed technical development officer at the Eston Refinery of E. Hind (South Bank), Limited, Imperial Works, South Bank, York. He received his technical training at the County Technical College, Wednesbury, graduating through the complete metallurgical and electrical engineering course. His practical experience was obtained by eight years on the foundry floor of Jas. Russell & Sons, Limited. In 1922, he was appointed metallurgist to J. & J. Siddons, Limited, grey and malleable iron founders and vitreous enamellers. Since 1929, Mr. Bradshaw has held various positions on the staff of Bradley & Foster, Limited. He has been lecturer in metallurgy at the County Technical College, Wednesbury, the Handsworth Technical College, Birmingham, and the British Foundry School. He has contributed several articles to the FOUNDRY TRADE JOURNAL, and read Papers before the Institute of British Foundrymen. In 1931, he presented the exchange paper on behalf of the Institute to L'Association Technique de Fonderie, on "The Enamelling of Cast Iron."

STANTON DALE

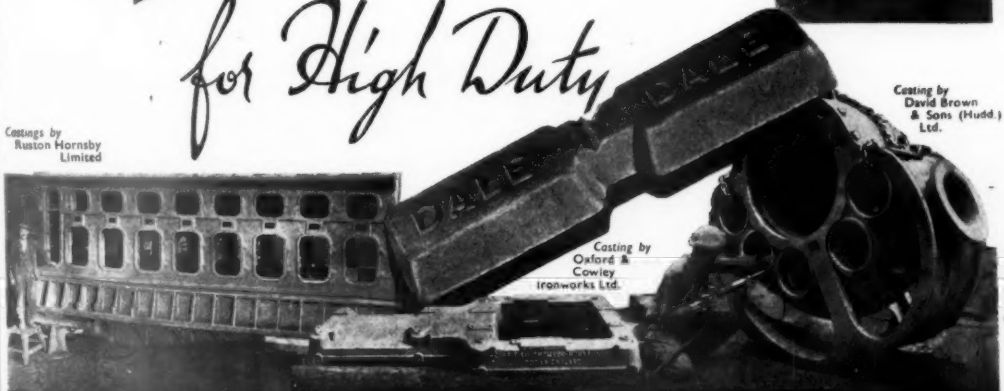
Refined PIG IRON

for High Duty

Castings by Morris Motors Limited.

Casting by Baker Perkins Limited

Castings by Ruston Hornsby Limited



Castings by Ruston Hornsby Limited

Casting by David Brown & Sons (Hudd.) Ltd.

Casting by Oxford & Cowley Ironworks Ltd.

THE STANTON IRONWORKS COMPANY LIMITED
NEAR NOTTINGHAM.

COMPANY RESULTS

(Figures for previous year in brackets)

Wales—Interim dividend of 5% (same).

Craven Bros. (Manchester)—Interim dividend of 5% (same).

G. Hopkins & Sons—Interim ordinary dividend of 6% (nil).

Braithwaite & Company, Engineers—Final dividend of 3½% (3%), making 6% (5%).

British Oxygen Company—Interim dividend on the ordinary shares of 7% (same), less tax at 9s. 6d.

Qualcast—Dividend of 10% and a cash bonus of 10% on the ordinary shares, making a total of 30% (same).

William Jones & Sons—Net profit for 1942, £675 (loss £164); to 2½ years' preference dividend, less tax, to March 31, £687 (nil); forward, £242 (£255).

Imperial Smelting Corporation—Dividend of 3½% on the 6½% cumulative preference shares, being the balance of the fixed cumulative preferential dividend for the year ended June 30.

Geevor Tin Mines—Net profit to March 31, £24,019 (£13,830); final dividend of 7½%, making 15% (12½%); tax, £4,500; written off shaft sinking and permanent development, £3,632; forward, £8,152 (£8,003).

Fricker's Metal & Chemical—Net profit for 1942, after tax, depreciation, and preliminary expenses, £3,511; brought in, £699; preference dividend, £1,180; ordinary dividend of 4% (2½%), £2,755; forward, £275.

Mellor, Bromley—Net profit, after taxation, for the year to February 28, £13,416 (£20,653); preference dividend, £3,575; final ordinary dividend of 5%, making 10% (same), less tax, £7,500; forward, £37,686 (£35,345).

Lang Bridge—Profit for the year to June 30, £25,947; directors' fees, £698; A.R.P. expenditure, £191; war damage insurance, £187; taxation provision, £20,520; six years' preference dividend, £3,750; ordinary dividend of 5%, £875; forward, £2,632 (£2,906).

Electric Furnace—Net profit for year to March 31, 1943, £54,544 (£50,821); dividends from subsidiaries, £5,320 (£4,240); provision for E.P.T. and income-tax, £32,000 (£28,000); to general reserve, £10,000 (£10,991); ordinary dividend of 8% (same); forward, £8,120 (£3,356).

Metal Traders—Gross profit to March 31, £34,107 (£52,285); income from investments, £1,486 (£502); subsidiary companies' dividends, £2,233 (£4,486); to salaries, etc., £29,841 (£33,970); to taxation, £2,863 (£9,500); net profit, £4,622 (£13,304); dividend of 6d. (1s.) per 2s. unit, £5,197 (£10,394); forward, £102,438 (£103,013).

THE TEES-SIDE LOCAL SECTION of the Royal Institute of Chemistry of Great Britain and Ireland will hold a scientific meeting on October 21, at 7 p.m., at Sparks' Café, High Street, Stockton-on-Tees. Mr. E. J. Vaughan, M.Sc., A.R.C.S., F.I.C., will speak on "Modern Methods of Metallurgical Analysis."

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Precision Productions (Hill & Company), 393, Staniforth Road, Sheffield, 9—£1,500. C. Hill.

Metal Smallwares Company, 320, Belgrave Road, Birmingham, 12—£100. E. G. Walthew and J. L. Hill.

H. Walton, 66-67, Edward Street Parade, Birmingham—Engineers. £1,000. H. Walton and S. A. Sault.

Geo. Johnston (Engineers), Berrington Chambers, 93, Tettenhall Road, Wolverhampton—£500. G. Johnston.

Farquhar Metallurgical Company—£10,000. J. W. Cooke, 70-71, Gracechurch Street, London, E.C.2, subscriber.

Brandon Electrical Engineering Company (Leeds), 63, Great George Street, Leeds. £1,000. J. and A. Cameron.

Churchley Bros.—Engineers. £5,000. W. F., S. C., and W. W. Churchley, 42, High Road, Wembley, Middlesex.

Raymond Gowing Engineering (Tolworth), 230, Tolworth Rise, Tolworth, Surbiton, Surrey—£1,000. R. A. and P. L. Gowing.

University Precision Engineers (Liverpool), 15A Georges Road, West Derby, Liverpool, 6—£1,000. J. D. and D. Branigan.

NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

554,734 PYRENE COMPANY, LIMITED. (Parker Rust-Proof Company.) Coating of ferrous surfaces.

554,774 ARNOLD, J. C. (MEDSKER, C. A.). Method of manufacture of composite metal slabs.

554,797 TRIGGS, W. W. (Carnegie-Illinois Steel Corporation). Brushing-apparatus for metallic strips.

554,829 BOSCH, F. J. G. VAN DEN., PURSER, D. J. C., SHANNON, D. S. B., and VACUUM-SCIENCE PRODUCTS, LIMITED. Process for rendering brittle metal ductile.

554,840 ESPERANZA COPPER & SULPHUR COMPANY, LIMITED, and LAWTHER, I. M. Furnaces for the treatment of iron ore.

554,897-8 GOWLAND, J. P. Apparatus for casting hollow metal articles.

554,903 FIFE, J. G. (Meehanite Metal Corporation). Supply of blast to cupola and like furnaces.

554,904 BROOKES, N. E. (Rust-Proofing & Metal Finishing Corporation). Protective coatings for metallic articles.

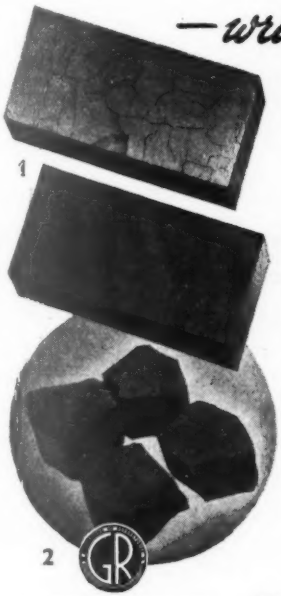
554,994 STEVENS, A. H. (American Steel Foundries). Car couplers or couplings.

555,025 FRIEDRICH, W. Forging and densifying hard bodies from hard metal alloys and the like.

555,058 BARRON, C. A., and BARRON, H. D. Wire-drawing machines.

THE PREMATURE END OF MANY REFRACTORIES

—written in Fireclay Joints



JOINTS are the weakest part of a furnace lining. Ordinary fireclay as a jointing material has certain fundamental disadvantages—it shrinks on drying and again on firing—the bricks do not remain bonded—and fireclay joints are readily attacked by slag. Durax No. 3 Refractory Cement for use with all types of fireclay bricks is a jointing material specially developed to overcome these serious disadvantages. It ensures the thinnest possible joints—sets hard without heat—and does not shrink during drying or firing.

Joints made with Durax No. 3 are as strong and as slag resistant as the fireclay bricks themselves. Its use ensures sound and homogeneous structures from which users can expect long life with a minimum of repairs. Full details on request.

DURAX No. 3 REFRACTORY CEMENT

NO SHRINKAGE. *Illustration (1) shows one firebrick coated with fireclay and the other with Durax No. 3. Both were allowed to dry at atmospheric temperature. The results are easily comparable in the photographic reproductions.*

STRENGTH. *Illustration (2) shows two test pieces allowed to dry at atmospheric temperature, and one fired to 1500°C. Tensile strength results — Unfired: 115 lbs. per sq. in. Fired: 912 lbs. per sq. in.*

FIREBRICKS. BASIC BRICKS
ACID-PROOF MATERIALS
CEMENTS. PLASTICS
INSULATION
SILICA BRICKS
SILLIMANITE. SANDS

General Refractories
LIMITED
HEAD OFFICE: GENEFAX HOUSE, SHEFFIELD, 10
TELEPHONE 31113 (6 LINES) 34.

Raw Material Markets

IRON AND STEEL

The Allies complete domination of the Mediterranean has restored access to valuable sources for the supply of hematite and other high-grade ores. Necessarily the volume of imports from North African and Spanish ports is governed by political and military considerations, and above all by the availability of transport. But some expansion of this traffic has already been noted with favourable reactions on the production of hematite and low-phosphorus irons, which are specially needed by the engineering foundries. These establishments are turning out very large tonnages of special castings for war purposes, and while the use of high-phosphorus iron and of other substitutes has been extensively practised, the prospect of increased allocation of low-phosphorus iron is a welcome development. Here and there jobbing foundries are maintaining a fair rate of operations, but usually they are concerned mainly with specialities. So far as the general run of both jobbing and light-castings establishments is concerned, conditions are slow, and this is reflected in the movements of raw materials, a condition which also applies to the textile-machinery foundries.

No difficulty is experienced in procuring supplies of foundry coke, and most consumers have substantial quantities in stock. The reserve supplies are likely to be of particular value during the winter months.

Production of sheet bars keeps well abreast of requirements, but there is steady pressure for mild-steel billets, and during the past few weeks increased tonnages have been delivered to the re-rolling mills. This, in turn, has reduced the use of imported material to small proportions, and has assisted the re-rollers in the execution of heavy programmes for the production of thin plates, light structural sections, etc. The busiest departments of the finished steel trade are the plate and sheet mills. Production has been forced up to the highest possible limits, but so heavy is the demand, not only from the shipyards and marine-engineering works, but also from tank, locomotive and wagon builders, boiler makers, etc., that delivery dates already extend into 1944. The section mills have an abundance of orders except for the larger sizes, and sheet mills are still working to capacity. Collieries are taking up their full quotas of roofing bars, arches, props, etc., which they obtain through the Ministry of Fuel and Power, the strain on the railways is reflected in increased requisitions for rails, chairs, points, etc., while the immediate consequence of the further expansion of the aircraft industry is the call for a still bigger output of special steel.

There has been rather more activity in the iron and steel scrap trade of late, due mainly to the interest shown by buyers in covering their forward requirements. Current needs are well covered on the whole. Inquiries for the heavy grades are particularly insistent, and merchants have no difficulty in disposing of all available supplies at maximum prices.

NON-FERROUS METALS

There is little change in the copper position from week to week; current supplies although restricted to essential users, are better than they have been for a long time past, and it is safe to assume that vital needs will continue to be fully covered. The shipping position dictates that extravagant use of the metal be banned, otherwise it would be possible to distribute copper among ordinary domestic users.

The supply position with regard to tin is that only demands from really important users can be entertained, and even their allocations have been drastically cut in many cases. As a consequence of the loss of several sources of supply, much research work has been carried out on the development of tin substitutes, with highly commendable results. In fact, so useful have certain of the substitutes been found that it is quite likely that tin will have difficulty, and may even fail, to recapture certain outlets again when supplies are once more plentiful. There is every reason to believe that enough tin will be available for the duration of the war to meet vital requirements, and that suitable alternatives will be on hand to make up for the output of the tinfields which have now fallen temporarily into Japanese hands.

There is no anxiety at the moment in respect of zinc supplies, despite the fact that distribution is confined to urgent war purposes only. The authorities are adhering to this policy mainly in order to conserve shipping for other cargoes. The same applies to lead, of which there are ample supplies for urgent needs.

THE WHESSOE FOUNDRY & ENGINEERING COMPANY, LIMITED, Darlington, will resume active occupation of their London offices at 25, Victoria Street, S.W.1, on September 15. They are vacating their temporary offices at Berkhamsted.

MR. GORDON FOSTER (trading as Foster & Company), Further Ford End Farm, Clavering, Bishop's Stortford, steel merchant, lately carrying on business or residing at 55, Broadway, Stratford, London, E. has been adjudicated bankrupt.

MEMBERS OF the West Riding of Yorkshire Branch of the Institute of British Foundrymen are to visit the foundry of the English Electric Company, Limited, at Bradford, on Saturday. A meeting of the Council will be held at some convenient time during the visit.

THE PARTNERSHIP between Malcolm Charles Stanislaus Bowley and Albert Edmund Furst, carrying on business as metal and produce brokers and merchants at 15-18, Lime Street, London, E.C.3, under the style of Malcolm Bowley & Son, has been dissolved.

THE YORKSHIRE BRANCH of the Institution of Mechanical Engineers are holding a meeting at the Metropole Hotel, Leeds, on October 2, when the chairman, Mr. G. Varley, M.Inst.C.E., M.I.Mech.E., will give an address on "Foundry Experience of High Duty Cast Iron."

TRADE SIROCCO MARK

FANS for FOUNDRIES

THE comparatively high pressures which are necessary in connection with the supply of air blast to forges and cupolas, or work of a similar character, requires the employment of a Fan possessing an exceptionally high standard of performance and operating efficiency. Such strenuous demands are adequately fulfilled by

"SIROCCO" HIGH-PRESSURE FANS

which are soundly constructed to give hard and continuous service with a minimum of attention. "Sirocco" Fans are manufactured in four different types, i.e., Cast-Iron High-Pressure, Single Inlet Cupola, Double Inlet Cupola, and Narrow-Pressure Fans.

Publication Ref. No. SF26, describing "Sirocco" H.P. Fans, is available on request.

DAVIDSON & CO LIMITED

SIROCCO ENGINEERING WORKS · BELFAST · N. Ireland

LONDON · MANCHESTER · LEEDS · GLASGOW
BIRMINGHAM · NEWCASTLE · CARDIFF · DUBLIN

There's no Casting-away money when you use

STERNOCORE

Whether Oil, Cream or Compound, the high efficiency gives better permeability, quicker drying, accurate cores, low objectionable gas content, and therefore, faster and cheaper production.

HIGHER PERMEABILITY

QUICKER DRYING

LOW GAS EVOLUTION

LOWER TRUE COST

REDUCED OBJECTIONABLE FUMES

STERNOL LTD., FINSBURY SQUARE, LONDON, E.C.2.

All Enquiries should be addressed to **Industrial Specialities, Dept. 34.**

Also at BRADFORD AND GLASGOW

Temporary Telephone: Kelvin 3871-2-3-4-5
Telegrams: "Sternoline, Phone London"

CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(Delivered, unless otherwise stated)

Wednesday, September 15, 1943

PIG-IRON

Foundry Iron.—CLEVELAND No. 3: Middlesbrough, 128s.; Birmingham, 130s.; Falkirk, 128s.; Glasgow, 131s.; Manchester, 133s. DERBYSHIRE No. 3: Birmingham, 130s.; Manchester, 133s.; Sheffield, 127s. 6d. NORTHANTS No. 3: Birmingham, 127s. 6d.; Manchester, 131s. 6d. STAFFS No. 3: Birmingham, 130s.; Manchester, 133s. LINCOLNSHIRE No. 3: Sheffield, 127s. 6d.; Birmingham, 130s.

(*No. 1 foundry 3s. above No. 3. No. 4 forge 1s. below No. 3 for foundries, 3s. below for ironworks.*)

Hematite.—No. 1 (S & P 0.03 to 0.05 per cent.): Scotland, N.-E. Coast and West Coast of England, 138s. 6d.; Sheffield, 144s.; Birmingham, 150s.; Wales (Welsh iron), 134s. East Coast No. 3 at Birmingham, 149s.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, 140s. 6d., delivered Birmingham.

Scotch Iron.—No. 3 foundry, 124s. 9d.; No. 1 foundry, 127s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, 174s.; South Zone, 176s. 6d.

Refined Malleable.—North Zone, 184s.; South Zone, 186s. 6d.

Cold Blast.—South Staffs, 227s. 6d.

(NOTE.—*Prices of hematite pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton.*)

FERRO-ALLOYS

(*Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.*)

Ferro-silicon (5-ton) lots.—25 per cent., £21 5s.; 45/50 per cent., £27 10s.; 75/80 per cent., £43.

Ferro-vanadium.—35/50 per cent., 15s. 6d. per lb. of V.

Ferro-molybdenum.—70/75 per cent., carbon-free, 6s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, 1s. 3½d. lb.

Ferro-tungsten.—80/85 per cent., 9s. 8d. lb.

Tungsten Metal Powder.—98/99 per cent., 9s. 9½d. lb.

Ferro-chrome.—4/6 per cent. C, £59; max. 2 per cent. C, 1s. 6d. lb.; max. 1 per cent. C, 1s. 6½d. lb.; max. 0.5 per cent. C, 1s. 6½d. lb.

Cobalt.—98/99 per cent., 8s. 9d. lb.

Metallic Chromium.—96/98 per cent., 4s. 5d. lb.

Ferro-manganese.—78/98 per cent., £18 10s.

Metallic Manganese.—94/96 per cent., carb.-free, 1s. 9d. lb.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms and Slabs.—BASIC: Soft, u.t., 100-ton lots, £12 5s.; tested, up to 0.25 per cent. C, £12 10s.; hard (0.42 to 0.60 per cent. C), £13 17s. 6d.; silico-manganese, £17 5s.; free-cutting, £14 10s. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £15 15s.; case-hardening, £16 12s. 6d.; silico-manganese, £17 5s.

Billets, Blooms and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £13 17s. 6d.; basic hard, 0.42 to 0.60 per cent. C, £14 10s. 6d.; acid, up to 0.25 per cent. C, £16 5s.

Sheet and Tinplate Bars.—£12 2s. 6d., 6-ton lots.

FINISHED STEEL

[*A rebate of 15s. per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.*]

Plates and Sections.—Plates, ship (N.-E. Coast), £16 3s.; boiler plates (N.-E. Coast), £17 0s. 6d.; chequer plates (N.-E. Coast), £17 13s.; angles, over 4 un. ins., £15 8s.; tees, over 4 un. ins., £16 8s.; joists, 3 in. × 3 in. and up, £15 8s.

Bars, Sheets, etc.—Rounds and squares, 3 in. to 5½ in., £16 18s.; rounds, under 3 in. to ⅜ in. (untested), £17 12s.; flats, over 5 in. wide, £15 13s.; flats, 5 in. wide and under, £17 12s.; rails, heavy, f.o.t., £14 10s. 6d.; hoops, £18 7s.; black sheets, 24 g. (4-ton lots), £22 15s.; galvanised corrugated sheets (4-ton lots), £26 2s. 6d.; galvanised fencing wire, 8g. plain, £26 17s. 6d.

Tinplates.—I.C. cokes, 20 × 14 per box, 29s. 9d., f.o.t. makers' works, 30s. 9d., f.o.b.; C.W., 20×14, 27s. 9d., f.o.t., 28s. 6d., f.o.b.

NON-FERROUS METALS

Copper.—Electrolytic, £62; high-grade fire-refined, £61 10s.; fire-refined of not less than 99.7 per cent., £61; ditto, 99.2 per cent., £60 10s.; black hot-rolled wire rods, £65 10s.

Tin.—99 to under 99.75 per cent., £275; 99.75 to under 99.9 per cent., £276 10s.; min. 99.9 per cent., £278 10s.

Spelter.—G.O.B. (foreign) (duty paid), £25 15s.; ditto (domestic), £26 10s.; "Prime Western," £26 10s.; refined and electrolytic, £27 5s.; not less than 99.99 per cent., £28 15s.

Lead.—Good soft pig-lead (foreign) (duty paid), £25; ditto (Empire and domestic), £25; English, £26 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, ex works, £37 12s. 6d.; rolled zinc (boiler plates), ex works, £35 12s. 6d.; zinc oxide (Red Seal), d/d buyers' premises, £30 10s.

Other Metals.—Aluminium, ingots, £110; antimony, English, 99 per cent., £120; quicksilver, ex warehouse, £68 10s. to £69 15s.; nickel, £190 to £195.

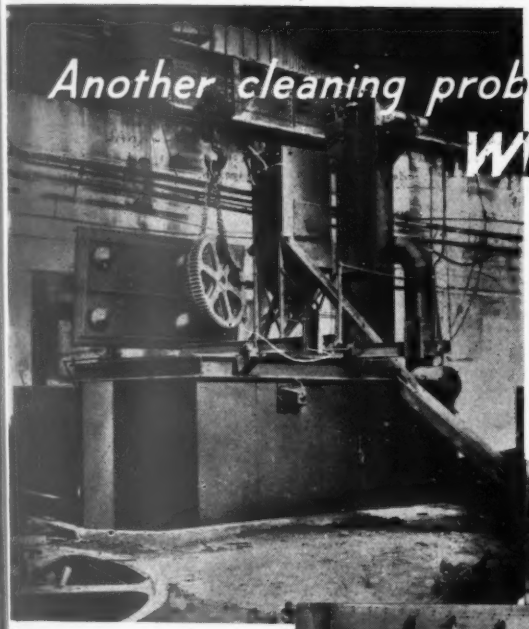
Brass.—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16d.; rods, drawn, 11¾d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 10¾d.; wire, 10¾d.; rolled metal, 10½d.; yellow metal rods, 9d.

Copper Tubes, etc.—Solid-drawn tubes, 15½d. per lb.; brazed tubes, 15½d.; wire, 10d.

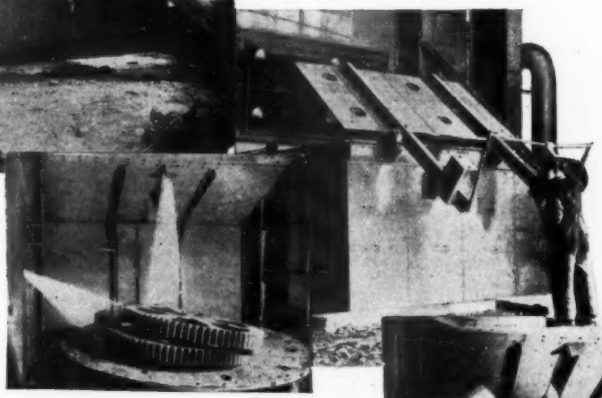
Phosphor Bronze.—Strip, 13¾d. per lb.; sheets to 10 w.g., 14¾d.; wire, 16d.; rods, 16d.; tubes, 21½d.; castings, 19d., delivery 3 cwt. free. 10 per cent. phos. cop. £35 above B.S.; 15 per cent. phos. cop. £43 above B.S.; phosphor tin (5 per cent.) £40 above price of English ingots. (C. CLIFFORD & SON, LIMITED.)

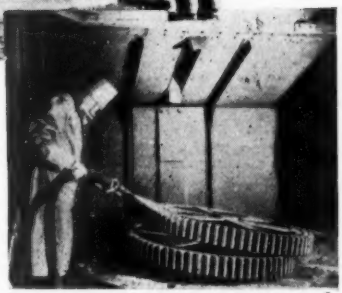
Nickel Silver, etc.—Ingots for raising, 10d. to 1s. 4d. per lb.; rolled to 9 in. wide, 1s. 4d. to 1s. 10d.; to 12 in. wide, 1s. 4½d. to 1s. 10½d.; to 15 in. wide, 1s. 4½d. to 1s. 10½d.; to 18 in. wide, 1s. 5d. to 1s. 11d.; to 21 in. wide, 1s. 5½d. to 1s. 11½d.; to 25 in. wide, 1s. 6d. to 2s. Ingots for spoons and forks, 10d. to 1s. 6½d. Ingots rolled to spoon size, 1s. 1d. to 1s. 9½d. Wire round, to 10g., 1s. 7½d. to 2s. 2½d., with extras according to gauge. Special 5ths quality turning rods in straight lengths, 1s. 6½d. upwards.

Another cleaning problem solved by a WHEELABRATOR



The Problem: To clean in a few minutes, large cored and intricate steel castings. *The Answer.* A room with two Wheelabrator wheels, one throwing the abrasive vertically, the other horizontally, on to the castings which are readily lowered by the crane through the roof. Any hidden parts not perfectly clean are then touched up by a Sandblaster. *Result:* 100% efficiency.





1. Castings being lowered through roof (the near half of which is closed to give better view) on to the revolving table in the room.
2. The operator closes the counterbalanced roof without effort. Roof doors are sealed when closed ; dust is exhausted at necessary points.
3. Castings being subjected to intensive automatic abrasion as the turntable revolves under the streams of shot from the Wheelabrator wheels.
4. The Sandblaster in protective clothing and receiving clean air, then touches up the very few hidden parts not reached by the thrown abrasive.

TILGHMAN'S PATENT SAND BLAST Co. LTD.

82 m. **17, GROSVENOR GARDENS · LONDON, S.W.1**

FOUNDRY
EST. 1902 TRADE JOURNAL
VOL. 71. No. 1413
Registered at the G.P.O. as a Newspaper
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL
SEPTEMBER 16, 1943
Offices: 49, Wellington Street, Strand, London, W.C.2
[Single copy 6d. By Post 8d. Annual Subscription, Home and Overseas 21/-

PIG IRONS
FOR ALL PURPOSES
•
PRIESTMAN
FOUNDRY COKES
•
"LEEFRA" REFRACTORIES
MANSFIELD MOULDING SAND
GANISTER · LIMESTONE · SEA SAND
CORE OILS · FOUNDRY BRUSHES & SUPPLIES
THOS. W. WARD LTD.
ALBION WORKS · SHEFFIELD
TELEPHONE: 26311 (18 Lines)
TELEGRAMS: "FORWARD, SHEFFIELD"